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Abstract

Dragon fruit (*Hylocereus spp.*) is one ofthe most important fruit crops in Vietnam, ranking firstin global areas and production. Recently, the planting area of dragon fruit has rapidly increased to approximately 28,500 ha, producing 585,000 tones of fruit per year. About 80-85 % of total fruit productivity is for export to more than thirty countries and territories, whichhas contributedto 203 million USD, accounting for nearly 45 % of total national fruit export value. Besidethe results of dragon fruit production and marketing in Vietnam are presented,the types of cultivars, advanced cultivationpractices and post-harvest techniques are introduced in this paper.

Key words：dragon fruit, production, cultivars, cultivating techniques, post-harvest, consumption.

1. INTRODUCTION

Dragon fruit (*Hylocereus spp.*) or pitaya, has been grown in Vietnam for at least 100 years, following their introduction by the French (Mizrahi et al., 1997). Locally, the fruit is known and sold as Thanh Long, or 'Green Dragon', a description associated with the green colour of the immature fruit, and the 'dragon-like' appearance of the 'scales' or bracts on the fruit surface(Hoa et al., 2006). Then, it has becomes popular among the wealthy families of the entire country. Vietnam has favorable climatecondition for growing tropical fruits which are mainly grown in the South of the Mekong Delta and in the Southeast, and Dragon fruit thrives in these areas. Because of having high economicvalue and

increase in international demands, dragon fruit production has been rapidly expanded to more areasin the country even in the North for recent years (MARD, 2014). Due to application of advanced cultivatingtechniques on production such us good agricultural practices (GAPs), the dragon fruit has been improved in yield and qualityto meet consumer requirements. Recently years, it has becamethe most important fruit candidate for export in Vietnam.In this paper, the achievements and cultivatingpractices on dragon fruit production and marketing in Vietnam will be introduced.

2. CULTIVAR TYPES

The two main cultivating types, including red peel and white pulp type (Hylercereus undatus) and red peel and red - purple pulp one (Hylercereus sp.) have been commonly grown in Vietnam. The white pulp cultivars, namely Binh Thuan(Figure 1a) and Cho Gaoas local varieties, have dominated in Vietnam for over 100 yearswith about 90 % growing area and production. These cultivars are self-compatible and perform oblong fruit shape with large and green scales, an average fruit weight from 360 to 380 g. The white flesh contains 14.9 ^{0}Brix, pH: 4.9 – 5.1,percentage of edible fruit: 73–75 % (Hang et al., 2014).

Figure 1.Fruit morphology of Binh Thuan variety (*H. undatus*)- a, and its hybrids: b- Long Dinh 1(Binh Thuan variety ×(*H. polyrhizus*) and c -Long Dinh 5(Long Dinh 1 ×Cho Gao variety(*H. undatus*).

The hybrid Long Dinh 1 (Figure 1b) which was created by crossing between Binh Thuan variety (*H. undatus*) as female and red flesh Colombia clone (H. polyrhizus) as male parent. It was resisted to Ministry of Agriculture and Rural Development and released to grower from November 2005.The main characteristics of this variety showsoblong fruit form with big and green bracts,about 380- 400g of average fruit weight, bright red peel and red-purple flesh, brix degree: 16-17%, pH: 4.7-5.7, 65-70% of edible fruit, easyfruit set without hand pollination.(Hanget al.,2014;SOFRI, http://sofri.org.vn/NewsDetail.aspx?l=&id=375&cat=7&catdetail=42).The hybrid Long Dinh 5 (Figure 1c) is hybrid of Long Dinh 1 and Cho Gao variety as a pollen donor. This cultivar was resisted to Ministry of Agriculture and Rural Development andreleased in 2011.Its good characteristics are self-fruitful, attractive fruit traits with an oblong shape, large and green scales and pink-purple flesh, an average fruit weight: 350-400 g, the brix sugar value: 16-180, pH: 5.03, percentage of edible flesh: 70-80% and good tolerance to some diseases and fruit quality is better than Long Dinh 1 in rainy season(Hang et al., 2014;SOFRI, http://sofri.org.vn/NewsDetail.aspx?l=&id=375&cat=7&catdetail=42).

Another type of variety with red - purple pulp which was introduced from Taiwan or resulted by breeding between the red-fleshed cultivars with the local ones has appeared several years ago.

3. PRODUCTIONAREAS, ACREACE AND PRODUCTIVITY

In 2000 the land area allocated to dragon fruit cultivation was about 5.9 thousand hectares and increased gradually to reach 9.0 thousand hectares in 2005, an increase of more than 50% (Figure 2). Five years later (2010) this figure increased nearly two times with just under15 thousand hectares. More surprisingly, during the subsequent periods of only three years later the area of dragon fruit trees planted has experienced a sharp rise with about 28.5 thousand hectares in 2013. As the results of the rapid planting dragon fruit development,

the fruit productivity also has remarkably increased at the same period (Figure 2). Vietnamese dragon fruit output obtained 55.9 thousand tons in 2001; 135.9 thousand tons in 2005; 328.3 thousand tons in 2010 and 585 thousand tons in 2013 (Tuan and Tien, 2011; MARD, 2014).

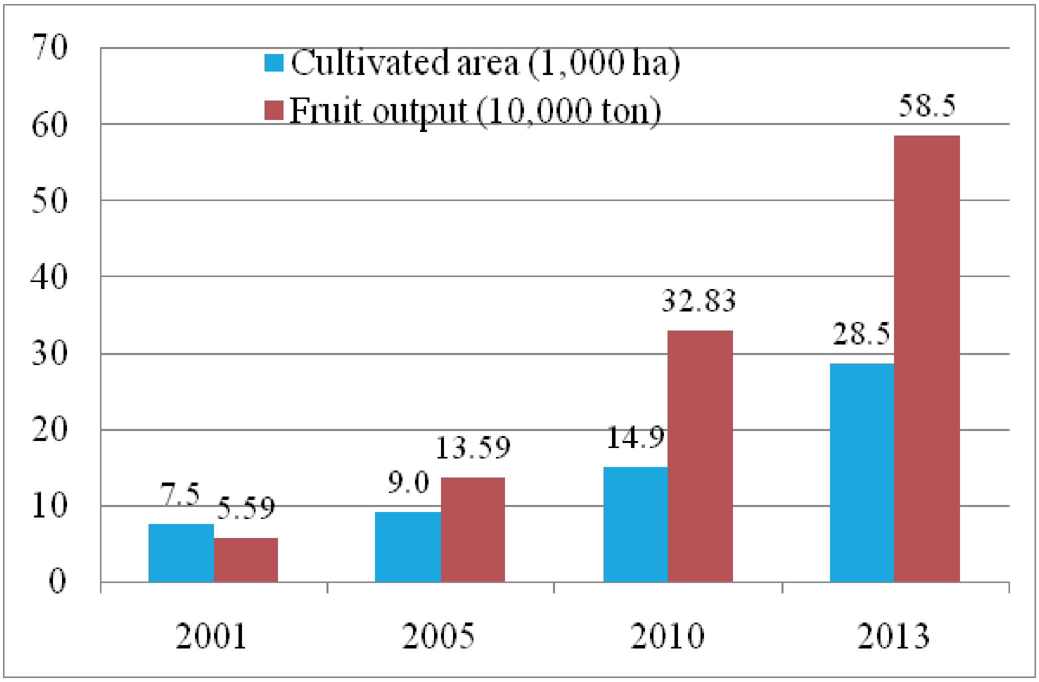

Figure 2. Trends in cultivating dragon fruit area and fruit productivity in Vietnam, period 2001 – 2013

Dragon fruits has been cultivatedin most eight ecological regions in the country. Binh Thuan provincelocated in the Southeast region is the main and origin of dragon fruit production area of Vietnam, which accounts for the largest planted area with 21,830 hectares in 2013 (76.6% of total planted area), producing about 460,000 metric tonsof fruit per year (78.6% of total nation output) (Figure 3). Binh Thuan also provides fruits with a good quality for export andsome parts of which have became famous region brands producing dragon fruit product as a specialty. The second largest area of growing dragon fruit are Tien Giang (3,000 hectares) and Long An(2,100 hectares) in the Mekong delta with 17.9%. Annual fruit productivity in here is about 102,000 metric tons, making up 17.5 % of total country output (MARD, 2014).

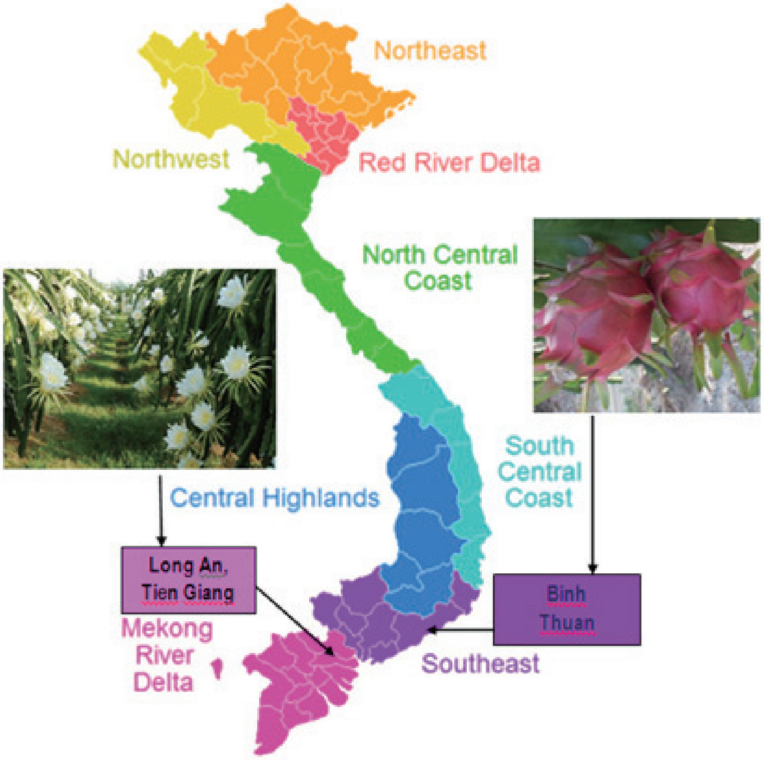

Figure 3. The two main areas of dragon fruit production in Vietnam

Other smaller areasare distributed in scattered provinces: Dong Nai, Ba Ria – Vung Tau, Tay Ninh in the South,Nghe An, Vinh Phuc, Hai Duong, Quang Ninh, Thai Nguyen and Ha Noi in the North,contributing only 5.5 % of planted area and 3.9% of fruit productivity inthe national total.

4.CULTURAL PRACTICES

4.1. Propagation

Most farmers propagate dragon fruit from cuttings. The cuttings are mostly obtained from annual pruning of mother plants, which makes a plentiful source of propagation materials. Mother plants selected for propagation are usually over one year old, of big dark-green shoots, disease-free, with big healthy dormant shoot buds. The cuttings may range from 20-40 cm in length.

Before being inserted into the propagation medium, the cuttings are submerged in solution of NAA 0.2 % so as to improve their ability to form new roots. Commonly, the medium for propagation is a mixture of soil : husk : coconut

fiber at the ratio of 1:1:1 (for Southern provinces), and/or a mixture of soil: husk : sand at the ratio of 1:1:1 (for Northern provinces). It is also required to treat the medium with Benlat C and/or Benomyl, to avoid fungal diseases and stem rot.The time of propagation may range from 3 to 4 weeks in the cool places (Figure 4). Some farmer households may skip raising dragon fruit cuttings in the nursery but directly plant them in the fields.

Figure 4. Vegetative propagation of dragon fruit from shoot cuttings

4.2. Soil preparation

In elevated regions which are high above the sea level such as the Central and Northern parts or Binh Thuan province, the preparation is simply to set stakes into the ground, did holes and fix supporting posts in the ground(Figure 5a). The most part of soil in Binh Thuan is impoverished grey soil, sandy soil or eroded mountain soil that need to fertilize with organic fertilizer (decomposed manure). After fixing the supporting posts, 20 cm depth and 40-50 cm width of soil are dug up around the post for manure application(cover with a layer of manure). Thereafter, the cuttings are planted around the posts.

In lowland and/or alkaline soil in Tien Giang and Long An provinces, it is

required to raise beds before planting. The beds are 40-50 cm high from water level in irrigation ditch to avoid flood in rainy season(Figure 5b).

4.3. Supporting post installation

Farmers in most of dragon fruit cultivation regions utilize concrete posts to support the plants these days ((Figure 5a, b), which surmounts disadvantages of the other types of posts as wooden columns and living wood trees. The concrete supporting posts are square columns of 12-15 cm in width, 1.6-1.8m in length, with 0.4-0.5 m buried in the ground, and 1.2–1.3 m above the ground.

4.4. Planting

Planting seasons

The time of planting dragon fruit depends mostly on the climate condition of the region. In all areas of concentrated cultivation, the plant is usually grown in months of October and November. During this time of the year, since pruning normally is carried out after harvest, a plentiful source of dragon fruit cuttings is available. Dragon fruit planted in October and November is quite young and small in size resulting to low resistance to heavy sunlight and draught, so it is necessary to mulch the plants with straw and water regularly during the hot season.

Under the condition of water scarcity, i.e in Binh Thuan province, the planting can be carried out in early rainy season (May–June). However, there may be a downside to the source of cuttings as this is the time the plant normally produces flowers and bears fruits.

Planting density

The common planting spacing is 3.0 x 3.0 m (equivalent to 1,100 posts/ha). The density makes it suitable for tending, flowering control at reasonable cost, and brings about higher benefits.

Planting technique

In all regions of dragon fruit farming, 4 cuttings of dragon fruit are planted around the post. The cutting can be vertically placed on the ground or 0.5cm

above the ground to avoid stem rot. A flat side of the cutting is placed against the plane side of the post to allow newly-formed roots to quickly bind to the post thereafter. In the beginning when there are no roots bind to the posts, the newly cuttings are tied to the posts with nylon or cloth straps (Figure 5a, b). After planting, cuttings are watered lightly and the soil is covered with straw and hay so as to maintain soil moisture.

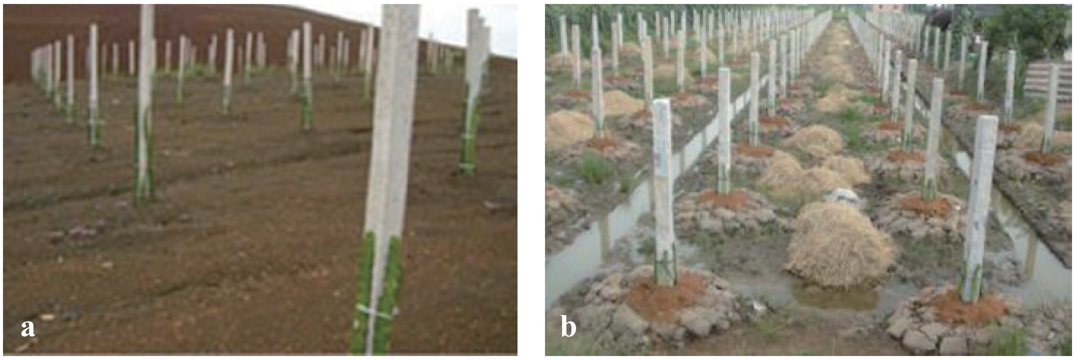

Figure5.Dragon fruit gardens have been newly planted from cuttings in the high land(a) and the low land (b).

4.6. Fertilization

Basal fertilizerapplication

In regions of the Central, North and Binh Thuan provinces, an amount of basal fertilizer, including 10-20 kg decomposed manure + 0.5 superphosphate + 0.2-0.5 kg lime is applied around the post. In lowland regions of Long An, Tien Giang provinces, rows or individual sites are mounded before planting; filled with manure, superphosphate and lime; then covered up with a loose soil layer.

For vegetative stage

Vegetative stage of dragon fruit may range in a duration of 1-2 years. The amount of fertilizer applied to the plants in this stage is normally divided into different times of application in order to improve nutrient uptake and reduce fertilizer loss. During the first year, monthly fertilization of 200g NPK (16-16-8 or 20-20-15) + 200g Urea is applied. Once the plants spread their vines to supporting metal frames fixed on the posts, more phosphate fertilizer is applied to promote the development of the root systems. Besides, leaf fertilizers, such as Growmore, Agrostim, Atonic, etc. can be used to stimulate the vegetative growth

resulting in bigger and heavier lateral shoots of darker green color.

For fruit-bearing stage

In the stage when the plant produces stable yield of fruits, the amount of fertilizer applied to plant each year is as follows:

- Manure: 20-30kg decomposed manure.

- Inorganic fertilizer: N : P2O5 : K2O applied in ration of 500g : 500g : 500g. In case NPK (20-20-15) is used, apply 2.5 kg NPK + 0.21 kg KCL to replenish potassium. In case single fertilizers (urea, superphosphate and potasium chloride) are used, the respective amount applied is 1.1 kg Urea+3.3 kg superphosphate + 0.8 kg potasium chloride.

During the stage of fruit formation, occurrence of flowers, flower buds and fruits usually happen at the same time, thus fertilizers are applied in different times to supply nutrients for fruit development. Farmers normally use 30-35% of the plants' total fertilizer requirement. The other part of fertilizer is applied in the stage of off-season flowering control.

In order to increase flowering, yield and fruit quality in off-season, farmers of intensive cultivation may apply an additional amount of 20-30 kg of decomposed manure to each post.

4.7. Pruning

Vegetative stage

About 15-20 days after transplanting, new branches are removed from the vine cuttings. Only the biggest and healthiest branches are kept on for further development until the top of supporting post is reached.Once the remaining branches get 30-40 cm long beyond the posts, they are trained to hang down. The training is usually carried out under the sunshine, when the branches become soft that enablebending down without being broken.

The plant needs light training to shape the canopy during the second year after planting. By the end of the third year, there remain about 100 branches densely arrange on the each supporting post. Branches produce fruits which are

inside the canopy should be removed for ventilation and to concentrate nutrients for new branches.

Fruit-bearing stage

In the stage of stable fruiting, two types of pruning are usually applied, as follows:

General pruning

General pruning is normally carried out after harvest and/or before the last harvest (end of August or September). Two-thirds of the branches are removed which are old, infected with pests and diseases, or situated inside the canopy, and only healthy branches remain. In this type of pruning, three-fourths of the length of branches which need pruning (30 cm from the main shoot base) are cut down. Then, new shoots will emerge from the remained part of the branches. Only 1-2 shoot buds are kept on each new branch. General pruning is easy to employ, less time-consuming and labor requirement. However, branches may criss-cross making an overlapped canopy.

Selective pruning

Selective pruning carefully removes unwanted branches which are weak, diseased to promote development of healthy branches. Selective pruning creates ventilation and avoids branch criss-crossing, nonetheless, it requires labor to conduct.

Decision on conducting general or selective pruning depends on cultivation circumstances and the orchard age so as not to cause any impacts on yield and economic benefits. Number of branches on each plant is also conditional upon how old the plant is. A one-year-old plant, for instance, may have 30 branches on it, a two-year-old may bear70 branches, a three or four-year-old may carry 100-130 branches, and up to 150-170 branches on a five to six-year-old plant.

4. 8. Irrigation, mulching and soil covering

Dragon fruit orchard in Long An and Tien Giang provinces are normally irrigated less since irrigation water level is often close to upper side of the beds.

Yet irrigation can be an interval of 3-7 days in dry season and depending on soil moisture and structure. In Binh Thuan, irrigation is usually done in months from November to May of the next year. Off-season flowering stimulation is carried out in the late rainy season and the early dry season so that irrigation is an important factor to obtain an effective flowering stimulation.In addition to irrigation, mulching the plant base to maintain soil moisture is another method to overcome water scarcity in dragon fruit cultivation, particularly in areas of long dry season. Straw or water-fern can be used to cover around the plant base or mulch the bed surface.Furthermore, covering pitaya planted soils by growing wild peanut (Arachis pintoi) instead of the straw bringsmany profits to growers (DTATDC, 2011; So,2013).

4.9. Flowering stimulation

Dragon fruit can be harvested from early April to end of October in Southern regions. Flowering stimulation is usually carried out in mid August and harvesting crops in late October and November. Farmers with good cultivation techniques can stimulate two off-season fruitings in months of August and March of the following year. Flowering stimulation on dragon fruit may be conducted with the help of growth stimulators and/or lighting. Growth regulators may cost less but flower uniformity is hardly met and the percentage of flower abnormal is high. Lighting in flowering stimulation is widely employed in cultivation areas in the south these days.Incandescent lights of 75W are popularly used in dragon fruit production. Light bulbs are hung between two posts at 0.7-1.2 m high from the ground, which ensures the sides of the canopy are received equal lighting(Figure 6).

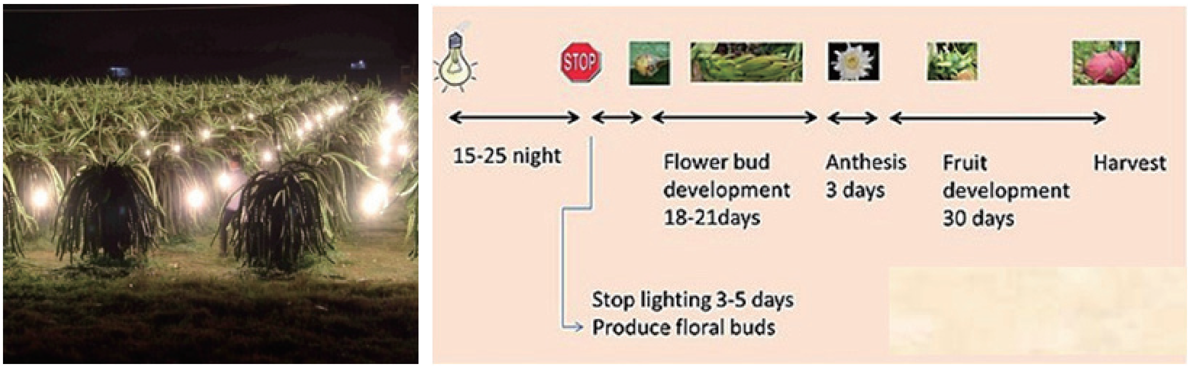

Figure 6. The lighting procedure applied to flowering pitaya induction in Off season

Lighting is normally done in 6-8 hours a night time, and continuously in 15-25 nights depending on the season and weather. The days of continuous lighting in early season is shorter than in late season. In the South, lighting can be shorten to 7 hours/night during 10-12 nights in February. After 3-5 days from halting lighting, flower buds start to emerge and develop in 20-21 days, then blooming and pollination may last 3 days. The fruits need 25-28 days to get ripe. Totally, it takes 75-80 days from lighting to harvest, depending on the time of the year in which flowering stimulation is conducted and weather condition in the cultivation areas. In the North of Vietnam, due to cold winter season, dragon fruit can only be harvested in main season which starts in mid June and finishes in late October. Lighting for flowering stimulation is not employedin there.(Ke, 2003; Hoa, 2008; DRDC, 2010; CPD, 2012).

4. 10. Pests and diseases

There are about 10 pests and diseases infecting on dragon fruit. The most popular damaged subjects are aphid (Pentalonia nigronervora), mealy bug (Pseducoccus brevipes), fruit-fly (Bactrocere dorsalis), thrip (Thrip sp.), anthracnose (Collectotrichum gloeosporioides), fungi (Macssonia agaves, Sphaceloma sp.), leaf rust (Bipolaris sp.) and soft-rot (Erwinia chrysanthemi). Those pests and diseases are effectively controlled byintegrated pest management (IPM), sothe yield and quality of dragon fruits are not damaged(Dien, 2006; Hoa, 2006; DRDC, 2010).

Recently, a new disease has occurred causing significant losses to dragon fruit production, namely brown spot (Neoscytalidium dimidiatum). Atpresent, there are no chemical or management method to effectively control the disease. To reduce impact of the disease on plants, at the stage of shoot burst it is suggested to applychemicals such as Propiconazole, Trifloxystrobin, Iprodione, Mancozeb with a frequency of 7-10 days /time, depending on the weather conditions (Hieu, 2011).

5. HAVEST, YIELDS, AND PRODUCTION TIMES

The harvest season for dragon fruits commences after the fruits change its color from green to red. The right time of harvesting is 28-32 day safter anthesis

(flowers blooming), when fruits are3 - 4 days aftercolor changing.For exporting,it is optimal to harvestfruits1-2 days earlier. The time for harvesting should be inthe early morning or late afternoon when the weather condition does not negatively affect the fruit quality and yield. The harvesting is done carefully using knife or scissorswithout damaging the fruits. The harvested fruits are put into bamboo baskets or plastic cratesandkept in a cool place, then transported to package warehouse as soon as possible.

(Hoa et al., 2001;DRDC, 2010;Thanh et al., 2011b; CPD, 2012).

The fruit yield depends oncultivar species, cultivation technologies, the ages of plants and seasons.Plants begin to bear fruits oneyear after planting. Fruit yield increases gradually to reach the peak of production in the fifth or sixthyear. In natural flowering condition (On season),Vietnamese cultivar orchards produce fruits with about 2.5- 5 ton/ha in the second year, 8-15 ton/ha in the third year, 20-25ton/ha in the fourth year and 25-35 ton/ha in the fifth-sixth year. However, the average yield performs a gradual decreaseand maintainsabout 20-25t/ha in thesucceedingyears(CTFA, 2011).

As the result of different growing condition, some red-fleshed species (H. polyrhizus or Hylocereussp.) introduced from other countrieshave beenless productive and resulted in lower fruit yieldcompared tolocal varieties. This is due to their low fruit set and small fruits in natural pollination (Hang et al., 2000; Tri et al., 2004).

In the South, dragon fruit plants can produce fruits almost all year round within 8-10 harvesting times and 2-3 times during off-season. The natural flowering season is from the middle/the end of March to October with 6-8 cycles, butmainly in summer months (May-August). In the Off-season (October – March),artificial flowering induction for fruit production can bemade by providing additional light during the short-day period. During cold season, the plants produce lower yield (15-20t/ha) but obtainhigher price than those produceduring the summer season.

(Ke, 2003; Thanh et al., 2011a,b; BTPPC, 2013).

In the Northern provinces, orchards bear fruits with lower yields than in the Southern provinces. Due to low temperature at the end of Autumn and in the Winter, so it is not effective to induce flowering for producing fruits in Off-season. The commercial fruiting season occurs in the summer months.

6. POST HAVEST MANAGEMENT

At the handling establishments, dragon fruit is washed with clean water, submerged inChlorine 200 ppm for 3 minutes to treat diseases and then in Ozone solution orBenomyl 500 ppm for 1 minute to treat bacterium. Water drying is operated with compress air sprayers or air blowers.Some other establishments of handling and packaging are currently treating dragon fruit by soaking the fruit in fungicide Umikai at concentration of 5 grams/2 litters of water for 5-10 minutes. Then, the fruit surface is dried from water in the same manner usingother chemicals(Figure 7).

After drying, dragon fruits are graded according to fruit weight which is defined by particular market requirements that are referred at the marketing section following. After being graded, dragon fruits are packed in carton boxes of 10-15kg depending on markets. Inside the boxes, dragon fruits are covered with holed polyethylen bags.The boxes are then stored in cool condition to be readyfor distribution to markets. Favorable storing condition is around 6-7℃ at moisture of 90%.The shelf life of fruits in this post harvest preservation can achieve from 30–50 days for white flesh varieties and shorter time for red flesh ones.It is optimal to transportfruitsto markets by cool container truckswith 5℃ and ventilation degree of 20–25 m^3/hour its inside during the cool weather(Hieu, 2011;Thanh, 2011b). Following to some foreign markets, export dragon fruits treated by the heating (at 46.5℃ for 20 minutes)(Hoa et al., 2006)or radiation treatment to eliminatefungal diseases and fruit fly eggs are required(Hieu, 2011; Thanh, 2011b).There are some enterprises to provide service of heating and/or radiation treating to agricultural products in Vietnam(Figure7).

7.MARKETING AND CONSUMPTION

The fresh fruits are consumed in both domestic nation (15 -20 %) and foreignmarket (80-85 % of total output). In the domestic marketing, fruits are sold

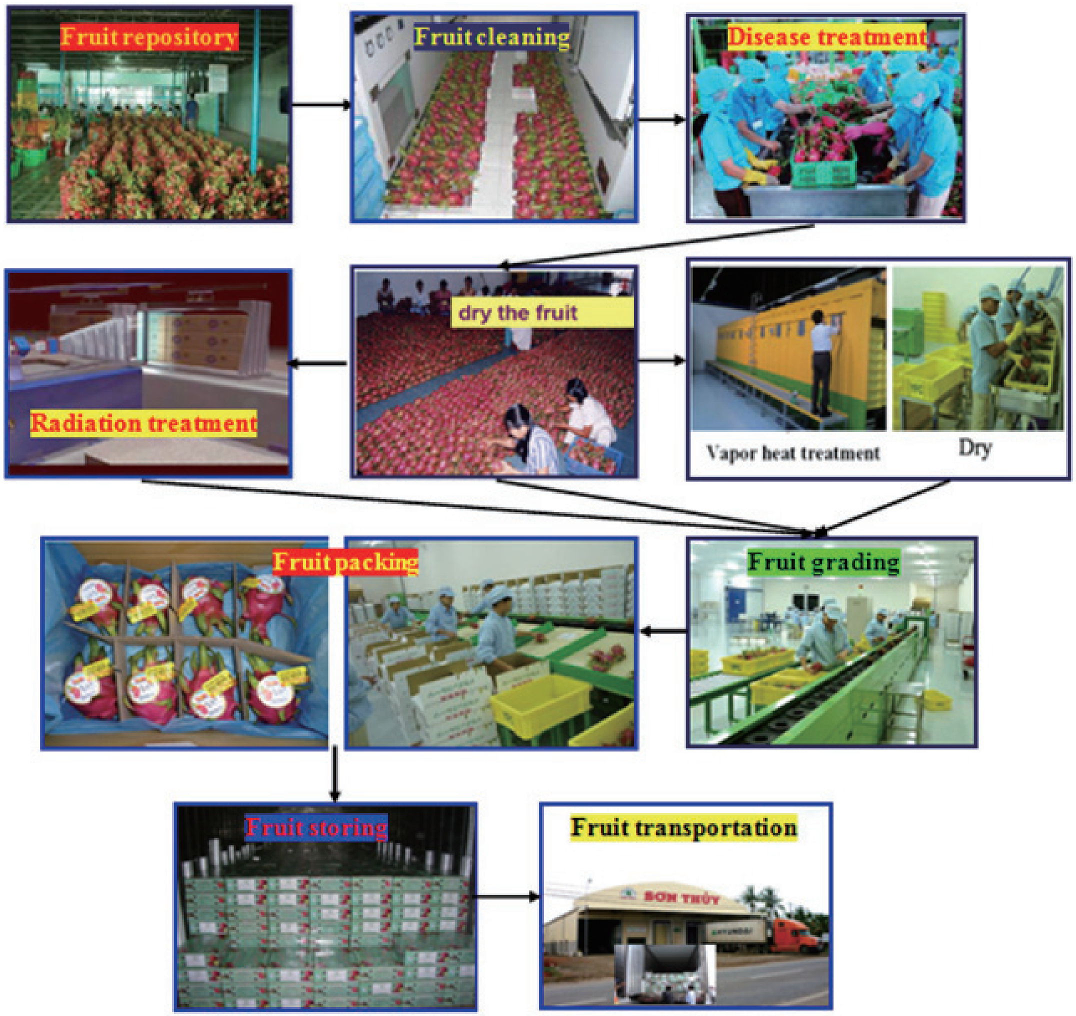

Figure 7. The process of post harvest management for dragon fruit in Vietnam

at local wet market and supermarket intwo forms: whole saling and retailing, otherwise they are bought and transported to other provinces by traders and then distributed to wholesalers and retailers at markets.To improve the value of products and promote dragon fruit cultivation, it is important to approach and expand international markets. The suitable production and storage procedures are applied to produce fruit products that meet consumers' demands. The GAP standards (VietGAP, EuroGAP, GlobalGAP) have been increasinglyapplied on dragon fruit production in Vietnam. "Regional brands"and "trade marks" for Vietnamese dragon fruits are also established and recognized by many countries in the world. As a result,more and more countries accept dragon fruits fromVietnam and most of the dragon fruit productivityis internationally

marketed. In the two past decades, theexport dragon fruit value has undergonea remarkably increasedue to the significant raise of export fruit price and output. In 2003 Vietnam obtained only 5.8 million USD from exporting dragon fruit(Figure 8). After only two years,this figureachieved 10.4 million USD, near two fold as opposed to 2003. Five years later (in 2010), exporting dragon fruit brought Vietnam 59.1 million USD, near six times compared to 2005. More interesting, the three succeeding years the value of fruit export continued to increase but more significantly ,reachinga new "record" with 203 million USDin 2013, accounts for nearly 45 % of total national fruit export value(MIT, 2014).

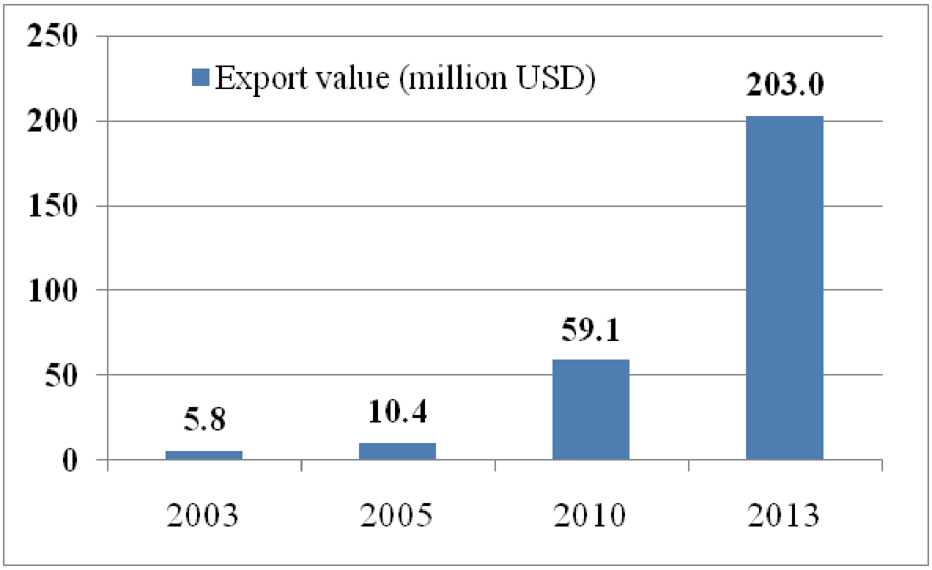

Figure 8.Trends in dragon fruit export value in Vietnam, period 2003 - 2013

The fruit price for export is much higher than that in domestic market. The price also varies upon different import countries where consumers have different demands. In 2013, Vietnam exported dragon fruit to more than 30 countries and China was the biggest consumer with commercial value of 145.2 million USD, accounts for 71.5 % of total export value(Figure 9).The following importers are Thailand (13.0 million USD, 6.4 %), Indonesia (9.9. million USD, 4.9 %), The United States (6.8 million USD, 3.3 %), The Netherlands (6.5 million USD, 3.2%), Canada (5.4 million USD, 2.7 %), Singapore (3.9 million USD, 1.9 %), Japan (2.8 million USD, 1.4 %), Hongkong (1.9 million USD, 0.9 %) and other countries (7.7million USD, 3.8 %) (Tri, 2013; MIT, 2014).

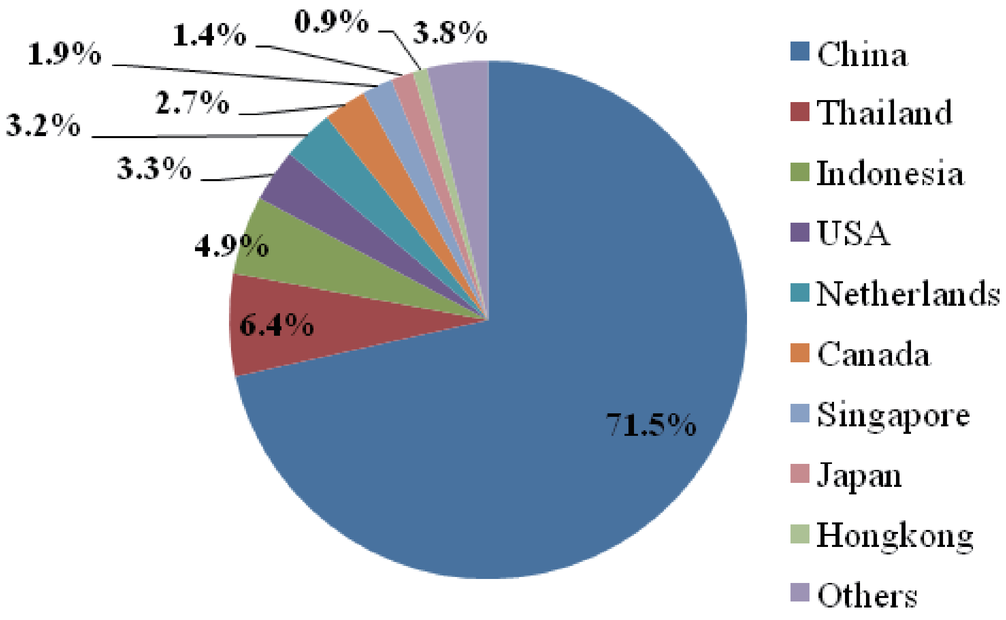

Figure 9. Share of Vietnam's dragon fruit export value by market, 2013

It is important to investigate and indicate the consumers' requirements in each foreign market. For instance, European countries, Indonesia, and the Middle East countriesnormally enjoy small fruits with 250-300 g/fruit of weight, while Chinese, Taiwanese, American and Canadian markets desire bigger fruits with 400-600 g. Japan and Singapore prefer fruits of weight from 300-500 g. In addition, fruits imported to Korea, Japanneed to be treated by heating before entering the market, while European and the United State require fruits treated by radiation. Recently, Vietnamese dragon fruits have agreed to be directly exported to the United States and then treated by the radiation before selling them on its market. Taiwan also demands the dragon fruits to be treated by the heating or radiation(Hieu, 2011; CPD, 2012).

8. CONCLUSIONS

With suitable climate and soil, Vietnam has been considered one of the most advantageous countries to cultivate and develop dragon fruit. In recent years, the remarkable development of dragon fruit production has brought great benefits to many horticultural farmers, traders and contributed a considerable amount of money to the national budget owing to fruit export. The great achievements in

dragon fruit production have resulted from the comprehensive and effective applications of many measures such as cultivating and harvesting technologies, crop managements, marketing policies, etc. Seizing comparative advantages of Vietnam' s superiorities in cultivating condition, farmers' experiences, markets and marketing, Vietnamese dragon fruit production should be developed more sustainably and efficiently in the future. Along with the plan of expanding planting area, methods of improving the quality and safety of dragon fruit will be used to meet the increasing requirements of consumers. The standards for fruit quality need setting and firm application. In addition to these, it is important to maintain and expand the international markets of dragon fruit. The "regional brands" and "trade marks" of Vietnamese dragon fruit are effective tools to draw the consumers' attentions.

Nonetheless, there is a need to conduct related studies on breeding new varieties with the following objectives: to obtain a good quality and yield fruit with a long shelf life, and to study the diseases affecting the plants, including its pest control, fruit production and postharvest fruit life.

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